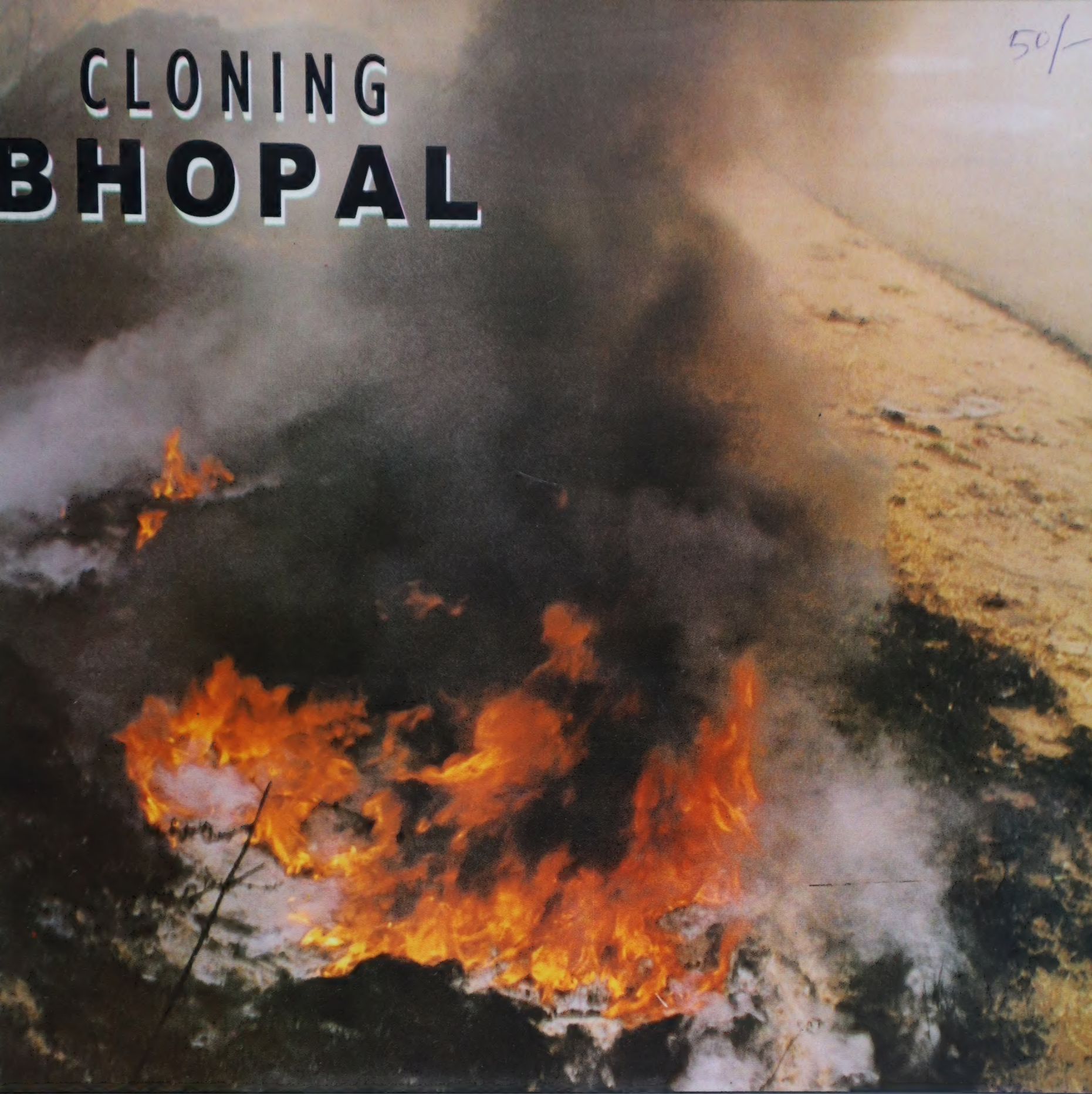


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Exposing the dangers in Delhi's environment

TOXICS *Link*
December 1999

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Exposing the dangers in Delhi's environment

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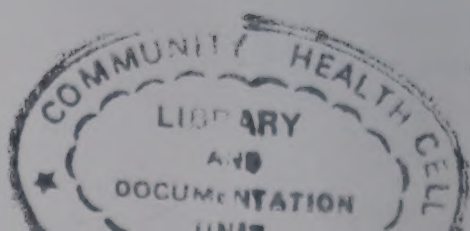
**Toxics Link
December 1999**

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Exposing the dangers in
Delhi's environment

Investigative and Author: Sushil Kumar, Shriya Singh, Bhopal Press

Toxic Link
December 1999



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About

Toxics Link

Toxics Link is a non-profit environmental justice organisation working towards freedom from toxic pollution. Operating since 1996, the Delhi based organisation has now opened nodes in Chennai, Mumbai and Bhavnagar. Toxics Link collects and shares information about the sources and dangers of toxics in our environment and our bodies, and about clean and sustainable alternatives for India and the rest of the world. The organisation is an information exchange which provides information to individuals and grassroots groups and networks with others working on environmental toxicity issues.

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Other Toxics Link reports, published and forthcoming:

- Not so inert after all!'-Fly ash: an environment and health perspective. A Toxics Link Briefing paper, September 1997.
- Landfills Deconstructed : 1998
- State wise compilation on the status of hazardous waste generation in the country.
- Common Effluent Treatment Plants: Technology, management and experiences.

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THE CONTINUING TRAGEDY

The night of December 2nd, 1984 has been marked in the history as the worst industrial disaster of the world, which left 8,000 dead, and 500,000 injured. While much attention has been given to the actual gas leak, little attention has been paid on preventing such disasters in the future. *Cloning Bhopal* is about moving forward by learning from the Bhopal disaster and avoiding such tragedies from happening in other places.

There is a consensus that several factors existed that made the leak as tragic as it was. There was a lack of appropriate regulation, as Union Carbide was not operating by code for several years. Though this is officially documented, the Indian government did not take any action to rectify the problem. When people complained of various problems such as nausea, eye irritation, foul smell from the factory and death of cattle, no heed was paid to their consistent complaints. No information was provided to the people living in the vicinity of the factory to protect their lives in case of a mishap. Even after the leak occurred, the company succeeded in hiding the fact that the gas released was methyl isocyanate (MIC). Had this information been disclosed earlier, people's lives could have been saved through the treatment of sodium thiosulphate. Till date, the Indian government and the public have not been able to force Union Carbide to disclose information. The lack of accountability on part of both the company and the government added to the sufferings of the Bhopal gas victims.

That fateful night in Bhopal....

On the night of 2nd -3rd December 1994, the gas leaked from the Union Carbide India Limited in Bhopal, a city with a population of approximately one million people. However, a gas leak was not new to the corporation as there had been a phosgene leak in 1981, in which a plant operator had died, then again in 1982, 28 workers were injured, and again in the same year in October, four workers had been affected. However, no attention was paid until the gas leak from the premises took a toll of 8,000 people and affected 500,000

The gas leak caught the people unaware -- children, women and men woke up from their sleep gasping for breath, surrounded by a poison cloud that was so dense that they could hardly see. With their eyes stinging and throats burning, thousands of people ran helter-skelter screaming for their lives. As they gasped for breath, the effects of the gas grew even more suffocating. The gases burned the tissues of their eyes and lungs and attacked their nervous system. People lost control of their bodies. Urine and faeces ran down their legs. Some began vomiting uncontrollably. Other were wracked with seizures and fell dead. The gases irritated peoples' lungs into producing so much fluid that their lungs were filled with it, "drowning" them in their body fluids. The ones who survived that terrible night died slow and painful deaths in the years following the disaster.

Life has become a living hell for the survivors of the tragedy. Fifteen years after the disaster, there are over 120,000 children, women and men who continue to suffer acutely from a host of exposure related diseases and their complications. 10-15 people die every month from exposure related illnesses and their complications. Indian Council of Medical Research has established that the toxins from Carbide's factory have seeped into the blood stream of those exposed and have caused damage to the lungs, brain, kidneys, muscles as well as gastro-intestinal, reproductive, immunological and other systems.

Source: Sambhavan Annual Report

INTRODUCTION

Well, if you think that the disaster at Bhopal was over 15 years ago in 1984, think again. Bhopals can happen anywhere. In fact, they are probably happening in your own city. Keeping the Bhopal gas tragedy as a backdrop, this report focuses on the impact of industrial pollution in Delhi, a subject given very little priority by politicians, media and the general public. If this is the state of affairs in the Capital where all the policy makers are present, one can imagine what happens in the rest of the country. The first section, gives a general overview of environmental problems in the capital followed by three case studies which discuss the environmental impacts of Delhi's rapid industrial growth.

DELHI

Sprawling over an area of 1,483 sq.km., Delhi ranks 4th amongst the world's most polluted cities. It has steadily been transformed from a historical 1000 years old capital to a modern, commercial and industrial centre. Dirty lanes, polluting industries, vehicles emitting exhaust and thermal power plants spewing out pollutants are all a routine part of living in Delhi. Historical structures such as Humayun's Tomb and Qutub Minar have deteriorated more during the past 20 years than in the 2,000 years that preceded it. Even the Lotus temple is wilting under pollution and has greyed since it was completed in 1986.

After independence, it was envisioned that Delhi be made into a city of ancient heritage and a reminder of India's courageous struggle for freedom. But unfettered development, governmental apathy and public ignorance has made Delhi a dying city.

The rapid growth of Delhi in recent times has resulted in significant increase in environmental pollution. There are many issues like vehicular pollution, industrial pollution, degrading water quality of the Yamuna and the problem of solid waste in Delhi that need immediate attention.

Vehicular population has increased phenomenally, from 2.35 lakhs in 1975 to 26.29 lakhs in 1996 and is expected to touch 60 lakhs in 2011ⁱ. 67% to the total air pollution load is due to vehicular pollution, whereas another 25% is generated by industries (13%) and coal based thermal power plants (12%)ⁱⁱ. The three thermal power plants in Delhi generate 6,000 metric tonnes (mt) of flyash every day. There are 19 drains, discharging over 2,800 million litres per day (mld) of municipal sewage, industrial effluent and waste water into the Yamuna. Municipal solid waste generation is estimated to be around 6,000 mt/day. Its disposal too poses a problem as most of the landfills are full. Now Waste-to-Energy projects mainly in the form of incineration is being promoted as an alternative. It is a well-known fact that incineration of unsegregated waste can result in the release of toxic compounds such as dioxins and furans amongst other toxic pollutants. India does not have the facility to monitor these cancer causing (carcinogenic) compounds which can be extremely hazardous to humans.

Air pollution, a slow poison....

It is a common sight in Delhi—innumerable people covering their faces with handkerchiefs in order to protect themselves from the pollutants in the air. Choked throats and burning eyes are evidence of degraded air quality. In winters, the smog is so dense that visibility at times becomes almost zero. It is estimated that about 3,000 metric tonnes (mt) of air pollutants are emitted everyday in Delhi. Emissions have increased from 1,700 mt/day in 1992 to 2890 mt/day

in 1995ⁱⁱⁱ. It is hence not surprising that air pollution has increased by a massive 75% over the last decade.

Such increases have not come without grave consequences. According to the Centre for Science and Environment, air pollution in Delhi kills one person every hour and is responsible for 9,859 premature deaths every year.

Bonfires in the city

Irrespective of the order passed by the Government of Delhi regarding the ban on burning leaves during autumn and winter, over 3,500 tonnes of leaves are reportedly burnt in Delhi, spewing out poisonous fumes into the atmosphere. According to environmentalists, this effect alone is equivalent to the emissions generated by 50,000 vehicles. Burning of leaves leads to the formation of sulphur dioxide, ammonia and nitrogen oxide and the thick black smoke that is emitted is laden with carbon dioxide and carbon monoxide. These chemicals can

Furthermore, according to a study conducted by the World Health Organisation (WHO), infants and children in Delhi are exposed to air-pollution levels equivalent to smoking four packets of cigarettes daily. The winter months from November to February are especially hazardous because air pollutants get trapped in the atmosphere. According to Dr Kamla Khetarpal, Professor of Respiratory Physiology at All India Institute of Medical Sciences (AIIMS), there has been a dramatic increase in the number of cases of respiratory infections and disabilities in the last few years.

The growing vehicular population is a major contributor to air pollution in Delhi. The effect of pollution caused by vehicles can be gauged at the ITO, Delhi's busiest intersection, during peak hours. Five minutes there and one gets a feeling of uneasiness in the head, irritation in the nose and throat, chest congestion and a burning sensation in the eyes. If that is the effect of a single exposure to noxious vehicular fumes, one can imagine the cumulative effect of exposure caused by regular commuting. With three million vehicles on the roads, up to 70% of the air pollution in Delhi is caused by vehicular pollution. And these figures are expected to rise with several new car models waiting to hit the roads soon.

In Delhi, vehicles primarily run on diesel or petrol. Diesel engines are responsible for harmful emissions of suspended particulate matter (SPM). These particles are small and are coated with polyaromatic hydrocarbons (PAHs) which are carcinogenic and have the potential to adversely affect the genetic make-up of human beings. Petrol run vehicles on the other hand, are responsible for the emissions of nitrogen dioxide, carbon monoxide and carbon dioxide. These emissions cause adverse health effects, including cancer, pulmonary and cardiovascular diseases. They also reduce the oxygen carrying capacity of blood and can cause bronchitis and bronchopneumonia.

With the growing concern about the environmental and health problems associated with the conventional fuels, cleaner fuels are being made available in the market. Compressed natural gas (CNG) is gradually becoming popular as a cheap alternative, because of the significant reductions in harmful emissions. In spite of this, it is still not a long-term solution, as it is a non-renewable resource. Availability of CNG is also minimal. According to Rajeev Sharma, managing director of Indraprastha Gas Limited, which is marketing CNG in Delhi, "in

Breathtaking facts....

- The rate of respiratory diseases in Delhi is 12 times higher than the national average
- 30% of Delhites are suffering from respiratory ailments.
- Each vehicle in Delhi consumes up as much oxygen in 960 kilometres as a human does during his lifetime.
- 3,000 tonnes of air pollutants are spewed out in the atmosphere everyday

Source: CPCB

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accordance to the directive by the Supreme Court, 80 CNG pumps would be put up in Delhi by March 2000, which would ensure its availability through out the city.

Water pollution

Though Delhi constitutes only 2% of the catchment area of Yamuna, it is responsible for about 80% of the total pollution load. Furthermore, the installed capacity for treatment is only 1,270 metric litres per day (mld) while Delhi burdens the Yamuna with over 2,800 million litres of wastewater daily. Because of this discrepancy, 70% of the discharge into the Yamuna is untreated. This results in unacceptable levels of bacteria such as Coliform, and also pollution from industries such as the power plants. The Najafgarh drain, itself, contributes 60% of the total wastewater that is being discharged into the river^{iv}.



Lifeless Yamuna : Cause for concern

Discharges of toxins into the Yamuna are difficult to document. For example, a study done by Prof. A.K. Bhattacharya of Jawaharlal Nehru University (JNU) in 1998, showed the presence of polychlorinated biphenyls (PCBs) in the Najafgarh drain which eventually joins Yamuna. According to a report by World Bank, Badarpur Power Plant still have transformers with PCBs. Such 34 transformers have been identified of which many have will removed from services without removing PCB oil. According to the Ministry of Environment and Forest (MoEF), PCBs were never manufactured in India and their import was banned in the year 1960. Dr. R. R. Khan (Director MoEF) says that "export and import of PCB based products are not regulated and was not banned either, it is only the waste containing PCBs which are banned. The PCBs are one of the 12 persistent organic pollutants (POPs) shortlisted by the United Nations Environment Programme (UNEP) to be eliminated and India has accepted this as per the treaty signed by them.

Solid Waste

The increasingly consumptive lifestyles of people living in Delhi have brought in the problems of municipal solid waste in the city. Living in Delhi is like living on a waste dump for the simple reason that during 1999, estimated quantity of waste generated was 8,203 MT per day. Despite the High Court's intervention and regular monitoring, the clearance/disposal was limited to only 4885 MT per day. With the present capacity of the civic bodies limited to handling the above quantum of solid waste, the present gap of 40% is likely to increase to 44% in 2001^v. In fact, the character of the garbage has undergone transformation -- it now includes large quantities of plastics, metals, glasses, chemicals and toxic waste.

Since the year 1950, over 12 large landfill sites have been packed with all sorts of non-biodegradable and toxics wastes. Presently, there are 3 operational landfills; Bhalaswa (16 ha), Gazipur(28 ha) and Okhla (7.2 ha) in Delhi and five more, Narela Bawana(60 ha) Bawana

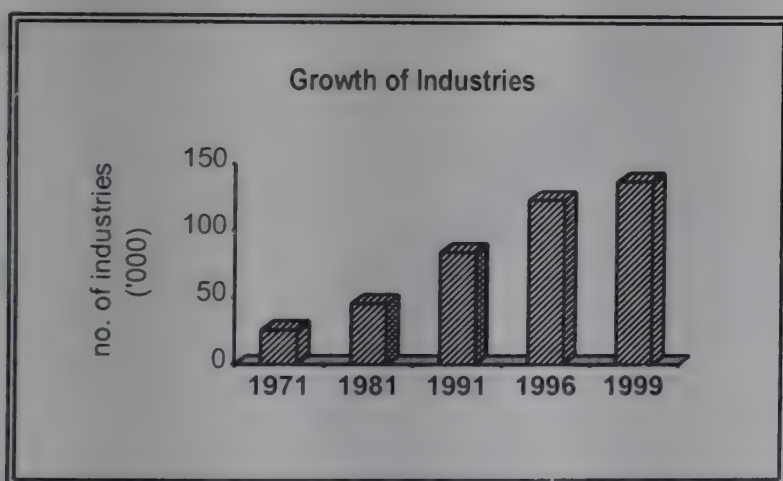
Kanjhawala (40 ha), Puth Khurd (56 ha), Kair (4 ha), Deorala (4.8 ha), Jaitpur (9.8 ha) are proposed. **None of the sites are engineered to safe specification and the case continues^{vi}.** Experts predict that at the rate at which they are being filled, these would soon be full and overflowing. Perhaps, more startling is the fact, that the hazardous waste is now entering the landfill waste-stream too.

CASE STUDIES

Due to the public pressure against the increasing pollution and congestion in Delhi, the Supreme Court (M.C.Mehta v/s The Union of India, 1996), directed that hazardous industries be moved out of the city and into the peripheral areas of Haryana and Uttar Pradesh. This directive was based on Delhi's Master Plan 2001, which has prescribed H(hazardous)-manufacturing industries to move out of Delhi within a maximum prescribed period of three years. The H-manufacturing designation encompasses about 90 categories of industries known to be hazardous to the environment and humans^{vii}. Recently Delhi Pollution Control Committee (DPCC) has allowed the reopening of 166 odd industries closed as per the 1996 Supreme court order. The reason given by the DPCC is that within a year they would install effluent treatment plants (ETPs) to treat the effluents.

According to the National Capital Territory (NCT)- Off-site Emergency plan 1998, the most significant hazards arise from the uncharted storage of chemicals and materials as there are many unlicensed and unauthorised industries, operations and activities. Cold storage facilities with considerable amount of ammonia gas, located in the various parts of Delhi also pose a hazard in the absence of the records and information relating to such activities^{viii}.

Small scale industries, remains a fact of life in Delhi. Despite the growing numbers of vehicles on the road, an estimated 25% of air pollution still comes from factories^{ix}. Till date, there are 28 conforming industrial zones and at least 29 non-conforming zones (Figure II).



There has been a phenomenal growth of industries in Delhi in the last 2-3 decades, where a sharp increase in the number of units from 26,000 in 1971 to 1,37,000 in 1999 has been recorded. Only 25,000 units out of total 1.37 lakhs are functioning in conforming industrial areas. The balance of about 1.10 lakh units are located in non-conforming areas^x.

According to Mr. R.K. Goel (Member Secretary, Delhi Pollution Control Committee, Government of Delhi), "the problem of controlling pollution and implementation is not in the hands of only one agency". He admits that "DPCC is not well geared-up to handle the pollution problems in Delhi". The Supreme Court order of closing down or relocation of the industries does not mitigate the existing problem of hazardous industries in the residential area. The responsibility of the respective departments to ensure the compliance becomes an issue of contention among themselves.

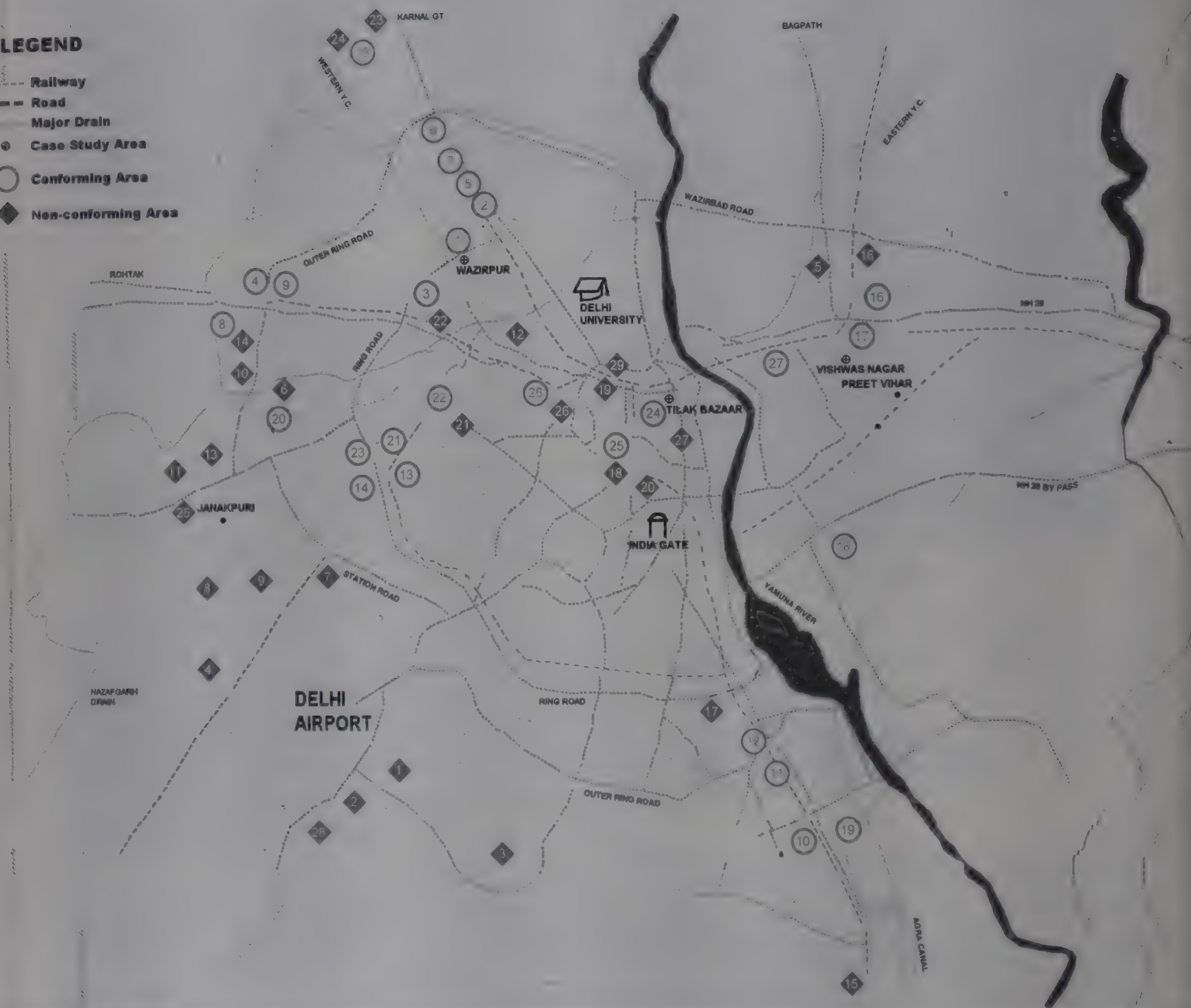
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MAP SHOWING CONFORMING AND
NON-CONFORMING AREAS IN DELHI

MAJOR CONFORMING AND NON-CONFORMING AREAS IN DELHI

LEGEND

- Railway
- - - Road
- Major Drain
- ⊕ Case Study Area
- Conforming Area
- ◆ Non-conforming Area



Non-Conforming areas of Delhi

1	Mahipalpur	16	Nand Nagari
2	Rangpuri	17	Kalkaji
3	Mehrauli	18	Motia Khan
4	Palam	19	Bahadurgarh Road
5	Babarpur	20	Connaught Place
6	Vishnu Garden	21	Shadipur Depot
7	Nangal Rai	22	Trinagar
8	Dabri	23	Samaipur
9	Sagarpur	24	Libaspur
10	Nangloi	25	Narela
11	Hastal	26	Karol Bagh
12	Shastri Nagar	27	Daryaganj
13	Uttam Nagar	28	Brijwasana
14	Jwalapuri	29	Azad Market
15	Badarpur		

CONFORMING AREAS IN DELHI

S.No	Name of the industrial areas	Activities undertaken	Sludge generation m ³ /d vol. Basis	Avg. wastewater generation m ³ /h
1.	Wazirpur Industrial Estate	Steel pickling	9.35	1022
2.	G. T. Karnal Road Industrial	Mixed	1.28	250
3.	Estate	Food	1.72	360
4.	Law rence Road Industrial Estate	Mixed	NA	NA
5.	Udyog Nagar Industrial Estate			
	Rajasthan Udyog Nagar	Pickling	NA	NA
6.	Industrial Estate	Pickling	5.71	833
7.	S.M.A. Industrial Area	Mixed	NA	NA
8.	S.S.I. Industrial Area	Mixed	5.64	445
9.	DSIDC Nangloi Industrial Estate	Dyeing	0.48	79
10.	Mangolpuri Industrial Area	Electronic	1.31	257
11.	Okhla Industrial Area	PVC & Mixed	1.97	341
12.	Okhla Industrial Estate	PVC & Mixed	NA	NA
13.	Okhla Flatted Factory	PVC & Mixed	5.07	871
14.	Naraiana Industrial Estate	Pickling	2.96	431
15.	Mayapuri Industrial Estate	Mixed	11.1	428
16.	Badli Industrial Estate	Mixed	2.26	660
17.	Jhilmil Industrial Estate	Mixed	NA	NA
18.	Friends Colony Industrial Estate	Mixed	NA	NA
19.	Patpargang Industrial Area			
	Mohan Co-operative Industrial	Mixed	3.04	684
20.	Estate	Mixed	NA	NA
21.	Tilak Nagar Industrial Area	Mixed	NA	NA
22.	Kirti Nagar Industrial Estate	Mixed	1.17	285
23.	Najafgarh Road Industrial Area	Mixed	NA	NA
24.	Moti Nagar Industrial Estate	Mixed	NA	NA
25.	Birla Mill Site on G.T. Karnal	Mixed	NA	NA
26.	Road	Pickling	4.49	871
27.	Jhandewalan Flatted Factories	Mixed	NA	NA
28.	Anand Parbat Industrial Estate	Mixed	NA	NA
	Shahdara Industrial Area			
	Narela Industrial Area			

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Conforming Vs. Non –Conforming

According to the Master plan for Delhi-2001 the conforming areas are the one which have been given the legal status as an industrial area. Any area is declared conforming by Delhi Development Authority (DDA), which comes under the Ministry of Urban Affairs. And once the area is declared conforming they have to comply with the various laws governing any industrial area. Whereas the industries situated very close to or within the residential area are non-conforming according to the Master Plan. Even by declaring any area as conforming does not solve the problem as Mr. R K Goel said that "such areas are historical problems as these industries should not have been allowed in the residential areas in the first place itself".

Each of these three case studies represents industrial areas with different official status. Factory owners in Vishwas Nagar, a non-conforming area where Poly Vinyl Chloride (PVC) cables and other products are being manufactured, are now fighting governmental efforts to shut their operations down. Although conditions in the steel pickling area of Wazirpur are not less toxic, it is an industry that is being allowed to continue with inadequate regulation. Finally, Tilak Bazaar represents an area that is not considered manufacturing but still presents a significant hazard to human health and the environment as it a trading market for all chemicals, dyes and solvents and there is little enforcement and regulation.

VISHWAS NAGAR – PVC cable manufacturing area

Home to one of the largest PVC cable manufacturing areas in all of Asia, Vishwas Nagar encompasses about 2,000 factories. Of these, the majority work in PVC granule manufacturing and PVC cable drawing. Other significant industries in the area are wire drawing, ice cream factories, chemical trading, electronics and garment manufacturing.

Vishwas Nagar is divided into two main areas called *Sarvaria Bazaar* and *Tash factory area*. The main road leading to Vishwas Nagar is subdivided into 30 lanes on both sides. PVC factories are situated in the midst of residential areas where people live just above these operations.

Reaching the market requires one to go through narrow lanes which reek of PVC, finally leading to the PVC market which one can make out from the barrels of chemicals, sacks of PVC resin and *dana*, plastic scrap, and an ear deafening noise from the machines and extruders. Most factories in this area barely cover an area of 50 square yards.

In Vishwas Nagar both virgin PVC and recycled PVC are routinely manufactured. Products made from recycled PVC however, make sub-standard items. According to a factory owner, glucose bottles, discarded PVC toys, pipes and other material is also used in making electric cables.

What is PVC?

PVC is short for polyvinyl chloride, or more commonly known as "vinyl". Over the past few decades, PVC has become one of the most widely used types of plastics. It can be found in home furnishings, children's toys, building materials, hospital supplies and many other products. Even though PVC is versatile and relatively inexpensive, the downside is that PVC is the most damaging plastic in the market today, causing environmental and health hazards at all stages of manufacture, use and disposal.

PVC Granule Manufacture

PVC *dana* or granule manufacturing entails the use of PVC resin (in the case of primary) or PVC scrap (in the case of secondary), di-octyl phthalate (DOP), stabilizer, calcium carbonate and chlorinated paraffin wax (CPW). The chemicals are mixed in different ratios depending upon the quality of *dana* required. For an excellent quality of *dana*, chemicals are mixed in the following ratio: PVC resin-- 25 kg, Calcium Carbonate-- 1 kg, Di-octyl Pthalate-- 10 kg, Chlorinated paraffin wax-- 4 kg, Stabiliser-- 1 kg. However, if an inferior quality of *dana* is required, calcium carbonate, which is the cheapest of all the above chemicals, is added in a huge quantity. This would reduce the durability of the product made from it but would increase the profit for the manufacturer. These chemicals are put in a mixer for at least half an hour to form a smooth paste. The paste is then fed into an extruder to form long tube like plastic, which is chopped to form granules. These are coloured according to the demand and then supplied further, to manufacture a range of products such as PVC cables, plastic bags and *chappals*. The cables that are manufactured here, have a market not only in Bhagirath Place which is Delhi's biggest electrical market, but are supplied all over the country too.

Health Hazards

From a health perspective, the chemicals of special concern in PVC production, are plasticizers, chlorinated paraffin wax (CPW) and stabilizers. Dioxin, which is an accidental byproduct of PVC manufacturing and incineration, is also a prime health concern.

Endocrine disrupters

Endocrine disrupters are an emerging health hazard of profound implication because they interfere with the normal functioning of the hormone system, which is instrumental in the development of organ systems and maintenance of the internal equilibrium of the body (homeostasis). Endocrine disrupters are synthetic chemicals which mimic or block the normal effects of estrogen, androgen, and thyroid hormones (and there may be other hormones that are affected which are yet to be discovered). Endocrine disrupters are implicated in reproductive dysfunction in both men and women such as low sperm counts and endometriosis, certain kinds of cancer (breast, testicular, and prostate), learning disorders, birth defects, and compromised immune systems

The most commonly used plasticizers are phthalates (pronounced "thal-ates"). PVC by itself is brittle, non-versatile and it degrades easily. Hence plasticizers are added to it to give the desired flexibility and strength to a PVC product. In fact, these are added in such large quantities that they account for nearly half the weight of vinyl products^{xi}. As a group they need more research study, but there is evidence in the existing literature that they are endocrine disrupters.

Though the effects of phthalates on human health requires more research, studies on laboratory rats show that phthalates harm the male and female

reproductive tracts, impair reproductive success, cause teratogenicity, and are carcinogenic to the liver and the kidneys^{xii}. Phthalates can travel great distances and have a global distribution. They are semi-volatile and are found in the atmosphere of primary PVC processing plants at levels of 0.02-0.5 mg/m³. This results in a significant exposure to workers^{xiii}.

Dibutyl Phthalate (DBP) is used in PVC manufacturing to make it more flexible and durable. This chemical has been banned in Japan for 20 years now. Still, the world output of DBP is 5 million tons annually^{xiv}. Short-term health effects include irritation of the skin, eyes, nose, mouth and throat. Chronic effects can occur a short time after exposure as well as for years after exposure. Known or suspected effects include damage to the developing fetus and testes. DBP has not been tested to see if it causes cancer or any other long term health problems^{xv}. A report by the United States Department of Health and Human Services concludes that the greatest potentials for exposure to DBP are to individuals who manufacture

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or handle plasticizers. However, there is no data present on the amount of exposure^{xvi}.

Di-octyl phthalate (DOP) is another plasticizer that is used to soften PVC. It is a thick liquid that has almost no odor. In 1982, the International Agency for Research on Cancer designated DOP as a possible human carcinogen. Although DOP is widely used in India, there is almost no information regarding the level of exposure workers face in the PVC industry^{xvii}.

Chlorinated paraffin wax (CPW) is one of the base ingredients in making PVC and is made by chlorinating paraffin wax. It is also used to soften the PVC and to make it flame retardant. Several problems exist with the use of CPW. Research shows that it bio-accumulates in aquatic organisms^{xviii}, and thus in the human food chain. The U.S. government agency, the Centers for Disease Control (CDC), reports that, "health effects due to exposure have not been investigated."^{xix} Properties of CPW, however, show reason for concern. The CDC, itself, states that dust explosions are possible if CPW is in a powdered or granular form and when mixed with air, it is combustible^{xx}.

Dioxin: It has been known since the late 1980's that dioxins are emitted from the PVC production process^{xxi}. Dioxins in general is the collective term for chlorinated aromatic compounds, consisting of a group called polychlorodibenzo-p-dioxins (PCDD) and consists of 75 congeners. These are one of the most potent and persistent toxins affecting humans today and are well-documented endocrine disrupters. These are toxic at levels as low as 0.006 picograms per kg of body weight. The International Agency for Research on Cancer (IARC) of the World Health Organization classified the most potent congener of dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD 2,3,7,8) as a known human carcinogen in 1997. Dioxins are one of the twelve Persistent Organic Pollutants (POPs) which are slated for global elimination under the current treaty negotiations being conducted under the auspices of the United Nations Environment Program.

Working Conditions

Although no official figures exist, locals estimate that there are approximately 20,000 workers in Vishwas Nagar. The vast majority of these are migrants from Madhya Pradesh, Uttar Pradesh and Bihar. Workers are required to perform 8-hour shifts, six days a week. Beginning salaries range from 1,200 to 1,500 rupees per month. If the worker is willing to put in an extra 2 to 4 hours a day of overtime, salaries can be a little higher.

During one of the visits to a PVC recycling unit, used PVC pipes were being shredded into small pieces and then put into an extruder for melting. The premises were laden with dust. One of the workers in this unit, Asha Ram, from Jalone (UP), who has been working here for the past 15 years said that "working under such conditions definitely affects his health but there is no other way". The doors of such factories which, already lack proper ventilation are kept closed at all times as these operations are illegal. This further exposes them to chemical laden



Drums of CPW lying in the open area

dust and fumes during the recycling process.

Another worker, Mata Prasad, from Gwalior, has been working in PVC *dana* manufacturing unit for the past 14 years. He said that people do suffer from health problems, such as chest congestion, due to working in this industry but personally he has not suffered any such health problems. A common treatment offered by local doctors to the workers is to eat jaggery (*gur*) daily in order to clean out the congestion.

Risk to the Residents

People living around the PVC manufacturing facilities are also exposed to the same health hazards as the workers. During power cuts, factories run on huge diesel generators exposing the residents to cancer causing chemicals such as polyaromatic hydrocarbons (PAHs) released from these generators. Finally, materials such as PVC resin and CPW, which are highly inflammable, are found in such large quantities on site that a fire in the area could be devastating for neighbors.

Jwalapuri: A PVC Scrap Market

Situated in the midst of the residential areas of West Delhi, Jwalapuri is a huge PVC scrap market. Plastic scrap comes here through a chain of rag pickers and *kabadiwallas* who go through Delhi's trash and collect PVC products. The scrap market has attracted several recyclers in the vicinity, where PVC is recycled.

In June 1995, the area was in the headlines of most of the newspapers because of a major fire that erupted here. The fire, which apparently started due to an electrical short circuit or through a lighted *bidi* butt, ravaged the entire market, turning the plastic scrap into a smouldering rubble. The area was covered by a thick black toxic cloud that seemed similar to the one in the Bhopal tragedy of 1984. After the fire, the Delhi government imposed a ban on the trading and stocking of PVC scrap or any other material of such nature in this area. They mandated the traders to move to Tikri Kalan, but never allocated the land to the traders. As a result, the traders started operating from Mundka village. Recently, the traders have resumed activities

The government has done little to prevent the return of the traders because no agency is willing to take responsibility for compliance. When questioned about the restarting of trading in Jwalapuri, the Delhi Pollution Control Committee (DPCC) shrugged its responsibility by stating that the area falls under the Municipal Corporation of Delhi (MCD), which is responsible to check the illegal activities such as this. The MCD, however, places the blame back on DPCC. With each agency pointing the finger elsewhere, there is no compliance and Jwalapuri remains a toxic hotspot

As a result, the residents of Paschim Vihar have moved to the Court. They have filed a Public Interest Litigation (PIL) alleging that before the massive fire in 1995, a number of minor fires had taken place. It alleges that more than two lakh people live in and around the Jwalapuri PVC market. If the traders resume their work, the residents claim they will again be exposed to noxious fumes and environmental pollution since the stockpiled materials are highly combustible. On our visit to the area, heaps of PVC scrap was being sorted by women and children. Huge quantities of discarded PVC bags were lying in the open ground which is a common site there. We were informed that fires are a regular feature in Jwalapuri with one major fire reported every year, while the minor ones go unreported.

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Water Pollution

A common practice in PVC *dana* manufacture is the use of water to cool down the semi-melted PVC wire. This water is replaced with fresh water when it gets too warm in order to maintain the correct temperature. According to a local shop-owner, the water is dumped into open drains, which outline Vishwas Nagar. It is well established that phthalates easily leach out of PVC because they are not chemically bound to the plastic. A study conducted in Saudi Arabia found that the majority of water sold in PVC plastic bottles contained phthalates^{xxii}. When dumped down the drains, these phthalates eventually leach into water, bioaccumulating in aquatic organisms. When humans consume fish or drink such polluted water, the phthalates can concentrate further in their fat, thus making them vulnerable to the health effects discussed above.

TILAK BAZAAR- A chemical market

For those who do not know Tilak Bazaar would probably walk through Chandni Chowk, enjoying the aroma of Indian spices without ever noticing that he or she is right next to Asia's largest chemical trading market. Entrance to Tilak Bazaar is through a narrow and dimly lit passageway right off of Khari Bawali, the main street in Chandni Chowk. Although the market takes up not more than one square kilometer in area, the variety and quantity of chemicals that can be bought is astounding.

The bazaar is made up of an "L" shaped main street which breaks off into many smaller winding aisles that are about 4 feet wide. Because of the huge crowds and the large number of workers carrying goods, the only way to traverse Tilak Bazaar is on foot. Traders operate from small shops packed together in three storey buildings. Steps leading to the second and third stories are often steep and unlit. Residents also live in the same building, which store the chemicals in the shops below. Locals estimate



Unsafe Transportation of Chemicals in Tilak Bazar

that there are approximately 2,000 storefronts operating in the market. The concentration and number of chemicals that can be found in the market are the main attractions. These two factors, however, also significantly contribute to the chance for a major disaster in the area.

Chemicals that are sold in the market come from manufacturing plants in Mumbai, Gujarat, and surrounding areas. The chemicals are brought by trains or trucked to Delhi from manufacturing units, which are then carted to Tilak bazaar in rickshaws. Due to the narrow and crowded lanes, the chemicals are delivered by workers on carts. It is also common to see workers carrying goods on their shoulders and backs.

In shops, people house all types of chemicals. Merchants say that one can easily stock a chemistry lab with the chemicals found in the bazaar. There is a separate section for solvents and acids.

All these shops have been operating without licenses for the past 5 years. The Municipal Corporation of Delhi (MCD) is unaware of the nature of substances that are stored and sold here. The Delhi government had apparently announced a land allotment scheme two years ago, in a bid to move these dangerous factories from this market. No land, has so far, been actually allotted and everything is claimed on paper. But the factory owners, who get cheap labour and raw material here, have not shown any interest in the proceedings either, even though their activities endanger the lives of thousands residing here.

The MCD has stated that no license for the polluting and fire hazardous trade has been renewed or granted after June 30, 1994, yet a full-fledged market in these chemicals was running there without any checks. Delhi Electricity Supply Unit (DESU) has allowed shops storing inflammable chemicals to crop up right next to its transformer, in violation of the existing norms. Between 1994 - 96, at least 55 people have been killed and over 500 shops destroyed in the various fires that have engulfed the area.

Migrant Labor

Although there are no official figures, locals approximate that there are about 10,000 workers in Tilak Bazaar. Some find permanent work in the shops and earn between 2,000 and 3,000 rupees a month. However, many labourers find work on an intermittent or daily basis. These casual workers do not have any benefits that the permanent ones have, such as payment for work related injuries. Their wages are also usually lower than 2,000 rupees.

Work Hazards

Workers generally claim that the work is not hazardous. Most of them, however, do not know what chemicals they are handling. One labourer, who was preparing to take a load to a factory, told us that he did not know what chemicals he was transporting nor did he know what it would be used for. Other workers informed us that if they are not careful, and the chemical comes in contact with their skin, the skin peels off and leaves blemishes. Brijesh Pandey and Mange Ram Diwedi from Gonda district (UP) are two-day labourers who transport chemicals on cart. They said that, "while transporting these chemicals, sometimes drums may crack or burst injuring workers. In storehouses (*godowns*), such accidents are common and go unreported." None of the workers in the market were seen wearing any protective gear. Based on workers' statements, it seemed that there is no training given to them regarding possible health hazards of chemicals that they handle.

The area not only poses danger to the worker who is handling the chemicals but to the community too living amidst the chemical storehouses. Given that the passageways of Tilak Bazaar are so narrow and congested, it is almost impossible for a fire brigade to come in and handle a situation in an emergency. A woman who has been selling vegetables just outside of the bazaar for several years says that there are usually one or two fires in the area annually. Both Chandni Chowk and Tilak Bazaar have heavy wiring along the streets and very often the cause of the fire is due to faulty wiring. Fires spread uncontrollably, lasting for days at a time and feeding on chemicals they encounter. According to a local source "once these fires start, they can not really be controlled, one have to just wait till they die out themselves".

During fires, chemicals such as nitroglycerine can lead to an explosion while emissions from chemicals like benzene can cause severe health effects. In case of spills, chemicals as common as chlorine could cause fumes enough to make people unconscious and nauseating. With the variety of chemicals and potential mixtures that are stored and a history of fires in the past, Tilak Bazaar is a potential disaster waiting to happen.

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Tilak Bazaar gives a picture of a sorry state of affairs, where so many things have gone wrong, from the condition of the roads to encroachments to the non-existent sanitation facilities and civic amenities besides complete lack of any fire safety precautions or norms which are being openly flouted by most of the shop owners.

Unauthorised construction and lack of adequate parking space in the area cause congestion. Inquiry reports by ADM north east, found unauthorised construction in all the shops, especially in their basements, as well as on the footpath and roadside, thus reducing the road space, meant to be 30 m wide to less than half its size.

Water Pollution and Solid Waste

While pouring the chemicals from barrels into smaller containers, there is a spillover that runs down the "nullies" along both sides of the streets. Even, the water used for washing the containers is drained into these open nullies. This mix of acids, dyes, solvents and other chemicals, can be seen flowing in these open drains.

Legal Requirements

Under the Environment Protection Act (1986), "The Manufacture, Storage and Import of Hazardous Chemicals", rules were passed in 1989 to ensure that chemical handlers appropriately warn employees, maintain a safe workplace and are prepared if an emergency situation should occur. The rules also place responsibility in the hands of different government bodies, called Authorities. These laws are applicable depending on the type and quantity of chemical that one is handling.

Some basic responsibilities of Authorities include^{xxiii}:

- Inspect the industrial activity at least once in a calendar year (Rule 3a).
- Prepare and keep current an adequate off-site plan containing details of how emergencies relating to a possible major accident on that site will be dealt with (Rule 14).
- Ensure that a rehearsal of the off-site emergency plan is conducted at least once a year (Rule 14).
- Make a full analysis of accident reports and channel them appropriately (Rule 5).

Some basic responsibilities of handlers include^{xxiv}:

- Gain approval from the appropriate authority before undertaking any activity. This information must include data on the chemicals that will be handled and the maximum that may be found on site at any given time (Rule 7).
- Notify the appropriate authority if there are any applicable changes in the operation such as the quantity or type of chemicals handled (Rule 8).
- Prepare and update annually, a safety report containing information on the industrial activity, identification of all possible hazards and description of how an emergency will be handled, at least 90 days before commencing that activity (Rule 10).
- Identify the major accident hazards (Rule 2a).
- Take adequate steps to prevent such major accidents and to limit their consequences to persons and the environment (Rule 2b-i).
- Provide to the persons working on the site with the information, training and equipment including antidotes necessary to ensure their safety (Rule 2b-ii).
- Take appropriate steps to inform persons outside the site who are likely to be affected about the nature of the major accident and the actions which should be taken in the event of an accident (Rule 15).
- Prepare and maintain a safety data-sheet to be accessible upon request. This should

identify characteristics, health hazards and safety precautions for each chemical (Rule 17).

- Properly label every container of a hazardous chemical clearly. This should identify the contents of the container, the manufacturer and the physical, chemical and toxicological characteristics of the chemical (Rule 17).
- Prepare and maintain an on-site emergency plan containing details on how major accidents will be dealt with and conduct a mock drill of the plan every six months (Rule 13).
- Notify the concerned authority within 48 hours should a major accident occur and furnish a report to the concerned authority with required information (Rule 5).

While the rules set up for chemical handlers are strong, there is very little adherence to the law. Currently, locals say there is no list of the types of chemicals that are sold in the market. Even Sushil Goel, the president of the bazaar's chemical association, claims that he does not know exactly how many chemicals are sold in the market. Even DPCC does not have the list of chemicals stored. This leaves much to be questioned about emergency preparedness in the area. Although the law requires labeling of all chemical containers, it is common to find containers without any identification. While an accessible safety data-sheet is required to be prepared for workers, we were told that even they did not know which chemicals they were handling. Finally, the most comprehensive history of accidents in the area could be obtained through old newspaper clippings. No central agency was able to provide us with a record of accidents in the area. In short, there seems to be so little information available about the market, it is unlikely that any of the provisions set up by the law are adequately followed by traders in Tilak Bazaar.

WAZIRPUR- Steel pickling industries

The Wazirpur industrial area is located about 25 kilometers north of the central Delhi district and spreads over 210 acres, the area is divided into 4 blocks A, B, C, and the Delhi State Industrial Development Corporation (DSIDC) area. This area was developed in 1966 under the second master plan for Delhi. Between 50,000 and 60,000 people work in this area. Twenty years ago, the area accommodated mostly hosiery factories. In the past decade, however, steel factories have moved in and have become a far more dominant industry in the area. Of the approximately 3,300 units in Wazirpur, about 80% are nameless and merely less than 20% of these units are registered^{xxv}.

Steel Production

The process of making stainless steel is quite extensive, as it requires repeated use of heat, acid, pressure and buffing. Steel rods are brought into Wazirpur to be cut into smaller square ingots that are about one foot square in area and 2 cm thick. These are then heated up in a furnace to make them pliable. The pieces are then put into a machine to flatten them. This process happens several times to produce a piece of steel that is of the desired thickness, and which is about 6 feet long and 1.5 feet wide. These pieces are then repeatedly dipped in sulfuric and hydrochloric acid to remove impurities. The end product is a higher quality product that we commonly call "stainless steel". After being dipped in acid, the pieces are then dipped in water and again sent through a furnace and rolling machine. Other factories in the area purchase the finished steel piece to create a variety of products such as plates, glasses and lunch boxes. These factories cut the steel to the desired shape shine the pieces, and then put them into a mold that shapes the metal. Because rough edges remain after the piece is molded, the edges are curled in, through the use of another machine. Finally, the product is buffed to give the steel its characteristic shine.

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These factories work round the clock without any break and the first shift starts from 9 am to 9 p.m. and the second goes on through out the night. Wages are the same regardless of the shifts and very little money is paid as over time. The owners usually maintain a small personal air-conditioned cabin in the factory, keeping a watch whereas workers stand in front of furnace with a temperature as high as 1000 –1500 °C

Health Hazards

In each step of the steel manufacturing process, the worker is exposed to acute and chronic health risks. Steel production is an accident-prone industry, even if one has the proper equipment, lighting, ventilation, and protective gear. Workers in Wazirpur however, do not have any of these and injuries and fatalities on the job are of common occurrence. In most of the units, labourers work in small, closed shacks made of brick or adobe. Debris of steel blocks, steel waste cuttings, and general product storage take up the vast majority of the space, leaving little room for workers to maneuver their way around the machinery and one another. Even during the day, there is no lighting other than what comes in through holes in the wall and from the heat of the furnace. Due to the poor visibility, the workers are not even able to see the shards of steel lying around which increases the chance of injury even more.



Hazardous working condition in conforming area

Workers stand directly adjacent to the open furnace, feeding sheets of steel into and pulling them out of the furnace with large tongs. There are no fans or ventilation mechanisms to diffuse the heat. Even in Delhi's temperate winter climate, standing next to the furnace is extremely uncomfortable. In the summer months, it becomes unbearable. Workers in this area often wear *chappals* or other open-toed shoes that do not protect the feet. Workers also have no protective clothing or face gear other than an ordinary cloth wrapped around their head to shield them from the intense heat.

The flattening machines are also located inside the shacks and are considered the most dangerous part of the steel manufacturing process. There are two types of machines used to flatten the hot steel. In the beginning of the process, steel is heated till it is red hot and then put into a press that flattens the steel from about 2-3 centimeters to a few millimeters. This machine is also the loudest, making it impossible to talk to the person next to you. Studies have shown that at these levels, permanent hearing loss is a common feature. Furthermore, other ailments ranging from hypertension to stress and fatigue have been linked to exposure to the excessive noise.

During the second flattening process, steel sheets are put through two rollers and squeezed to become even thinner. In this process, it is common for small shards, or pieces of steel to get cut from the edges and to shoot out like bullets towards the worker. If hit in the chest area, it is

common for the shard to cut through the skin and ribs and kill the worker. Shards also hit in the arms and other parts of the body where they make large gashes that must be bandaged. Accounts have also been given of shards coming out at such an angle that it misses the worker but can hit and injure others walking-by outside the factory. In this area, workers wear a thin layer of leather on their chests while their arms and faces remain exposed.

While the acid areas are located outside the shacks, the fumes are still overpowering. New regulations have pushed factory owners to install fans above the acid baths that help direct the fumes upward and away from the worker. Still, the concentration of the acid that is used is so strong that people passing by will feel asphyxiated and will start to cough. When the acid is poured, a thick yellow smoke can be seen wafting from the bath. Factory workers, themselves, say that at times it is so strong that they want to just go home but they have no choice. This is the only area where workers wear knee high boots and gloves. Even so, it is inevitable that in the lifting and dipping, acid get onto the workers' clothes and skin. There is no protection for that.

After the steel has been molded into a utensil, the piece goes through a machine that curls the rough edges. Here too, workers do not wear gloves. They quickly replace each piece of steel onto a moulding machine that has a heavy and spinning hand that comes down onto the piece. Finally, the piece has to be buffed to give it the shine we are accustomed to seeing in steel. This process is also very dangerous as workers work in minimal or no lighting to buff the steel with a coarse steel wool sort of abrasive that is wrapped onto a rapidly spinning wheel. Here, again, workers fingers are unprotected.

Work injuries

The hazards present at these factories are well documented by the number of injuries and health problems that people face. Dr. K. K. Goel, who has a clinic in the heart of Wazirpur, says, he sometimes gets 50-60 patients a day with work injuries. Respiratory problems are common not only amongst workers, but people living in the neighbouring areas as well. Workers often come in because they have had steel shards shoot into their arms or front of the body during the flattening process. According to the local sources one worker died in the plot number B-35 as the shard pierced his heart which they say is quite common.

Labour's condition

Most people come from Bihar, M.P. Orissa and U.P. to work in Wazirpur. Many say that it is very difficult to find work except in the big commercial and industrial centres such as Delhi and Mumbai. Most of the workers have temporary jobs and do not have any kind of insurance and social security provisions. They live in the residential squatters within the Wazirpur industrial area, which are over crowded and dirty. Abysmal sanitary conditions, absence of any basic amenities, open sewers, free flowing toxic waste, filth and flies characterize the place..^{xxvi}

At nineteen years, Mukesh Kumar came from Bihar due to no job availability there. He is now making about 1,400 rupees per month for working from 9 am to 9 p.m. He is given a half-hour lunch which he spends with co-workers in the factory. By working a 4-hour overtime shift, he says he can earn about 1900 rupees per month.

Another worker, Chandar Prakash, has been in Delhi for almost 7 years. He has been working at the same steel factory for that amount of time. He is now making 2,000 rupees per month. He says, however, that his boss is very good because anytime anyone gets hurt, the boss pays for all the medical expenses and pays for days that the labourer is out of work. When someone dies, the family is paid anywhere between 20,000 to 100,000 rupees. When asked if he feels

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this work is very dangerous, he replied that, "you can get hurt just walking on the street. When it is your time to go, the one above will take you."

Water pollution and solid waste

It is not only the workers that face extreme health hazards from the steel manufacturing industry. Families of workers live right in the midst of this cluster of factories. Due to the lack of adequate measures taken by factory owners and the lack of adequate sewage and drainage systems, acid laden wastewater fills the *nallahs* on many streets. In the wet season, these *nallahs* overflow, forcing people to walk directly in the brew of chemicals and waste. Children walk barefoot or with *chappals* through the overflowing sewage.

Even the water people use for daily chores such as taking baths and washing their clothes and dishes is contaminated. Acid that has been spilled onto the ground over the past few decades has now seeped down enough to burn through the water pipes and has contaminated the water supply. One anecdote told by locals is that at one point, even when the water supply was stopped, there was liquid coming from the pipes. It was later discovered that this is from the acids and other wastes that are leaking into the pipes. Though the government recognizes the problem, there has been no cleanup to date.

The steel manufacturing industry has also produced a significant solid waste problem. Due to an inadequate sewage system, waste from the industries sits in piles near the *nallahs* alongside the streets. This waste has been found to be very high in metals, particularly iron^{xxvii}. The waste is also highly acidic, having an average pH of 3.53^{xxviii}. This high pH and strong presence of iron is due to the acid washing process of the steel. Here, sulfuric and other acids are used to remove the iron and thereby "purify" the steel. The solid waste generated in the Wazirpur industrial area is estimated to be around 9.35 m³/day with pH of 7.2^{xxix}. The heavy metal concentration in the sludge generated is given as under:

Heavy metal conc. (mg/kg) in the sludge generated in Wazirpur Industrial Area								
Copper	Zinc	Iron	Chromium	Lead	Nickel	Cadmium	Manganese	Regulatory Quantities (Waste Category No.3 *)
2219	160	79791	17729	11	2021	38	8621	10, kg /year the sum of the specified substance calculated as pure metal.

Source: NEERI report

Hazardous Waste (Management and Handling) Rules, 1989

The table shows a very high concentration of heavy metals out of which iron, manganese, zinc and copper are the micro-nutrient and chromium, nickel, lead and cadmium are the toxic heavy metals. Since nitric and sulphuric acid are used in the pickling process, the resultant waste has a very low pH. The waste is seen lying around along the lanes in huge heaps, therefore has all the possibilities of toxic metals leaching into the surface.

The steel manufacturing industry in Wazirpur is leaving a legacy of acid and metal contaminated waste and water that we will have to deal with perhaps for generations after the contamination has occurred.

In Wazirpur, which is one of the conforming areas, if an acid bath is kept outside the factory premises it doesn't come under the purview of DPCC but becomes a problem of MCD as an illegal encroachment.

Unlike the large Bhopal gas leak that killed thousands in a few hours, the steel manufacturing industry kills people slowly everyday. Through every aspect of the process, workers are exposed to high risks. They work in unacceptable conditions, with lack of lighting, ventilation, in extreme heat, and without adequate protection of any part of the body. What is the price to be paid for the slow deterioration of health and for facing such risks daily? These days, it is priced at about 1500 rupees a month.

EMERGENCY PREPAREDNESS

An emergency plan called "National Capital Territory of Delhi: Off-Site Emergency plan" was prepared by the Delhi government in May 1998. The government of Delhi has nominated the Deputy Commissioners of the nine districts as District Emergency Authority for the respective districts as required under the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989. The scope of the plan covers only emergencies arising from accidents in Delhi involving chemicals and a three tier crisis group was proposed at the state, district and local levels. The State Crisis Group has been chaired by the Chief Secretary with Secretary (labour) as Member Secretary and other department represented in the committee are health, industries, public health engineering, CPCB, transport, police, fire, representative of oil companies and with a provision of nominating four experts.

As per the "Off-Site Emergency Plan" some units have been identified in Delhi and the potential off-site damage distance is given below.

S.No	Hazard unit	Material of concern	Quantity	Nature of risk	Damage distance
1.	IOC Bijwasan	Motor spirit	9000 kl	Fire	42m
2.	BPC Bijwasan	Motor spirit	4500 kl	Fire	24m
3.	BPC IGI Airport	ATF	6000 kl	Fire	35m
4.	IOC Airport	Motor spirit	5000 kl	Fire	40m
5.	HPC Shakurbasti	Motor spirit	2000 kl	Fire	42m
6.	BPC Shakurbasti	Motor spirit	4500kl	Fire	30m
7.	LPG Bottling Gharva modh	LPG	600 te	Fire Explosion	1010m 1200 m
8.	Chandrawal I & II	Chlorine	910 kg	Toxics gas	Down wind 5800m in 90 sec
9.	Wazirabad W.W.	Chlorine	910 kg	Toxics gas	Down wind 5800m in 90 sec
10.	Haiderpur WW	Chlorine	910 kg	Toxics gas	Down wind 5800m in 90 sec
11.	Indrapastha G.T.P.S	Naptha	4000 kl	Fire	38m
12.	Badarpur	Chlorine	910 kg	Toxics gas	Down wind 5800m in 90 sec
13.	Okhla STP	Biogas	5660 m ³	Explosion fire	66 m 200 m
14.	Rithla	Biogas	5660 m ³	Explosion fire	66 m 200m
15.	Bhagirathi W.W.	Chlorine	910 kg	Toxics gas	Down wind 5800m in 90 sec
16.	IOC Bottling Plant Madanpur Khadar	LPG	100 te	Explosion fire	560 m 680 m

Source: NCT: Offsite Management Plan

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According to the plan, each cluster should have a well-designed emergency control room equipped with the following facilities.

- High integrity communication system, linked with the industries and the risk handlers in the areas, risk handlers in the area, district authorities, and emergency response agencies;
- Updated information on the hazards present in the area and inventory of the properties of hazardous material;
- Meteorological station providing wind velocity, direction and atmospheric stability for real-time simulation of accidents
- Computing system with suitable emergency response software capable of simulating effects of toxic releases, fires and explosion.
- Detailed map of the area showing location of the industries, residential areas, sensitive locations, water courses and access route;
- Emergency response (HAZMAT) van for on scene assessment and response of the incident equipped with facility for communications, sampling of toxic gases, personal protection etc.

The above listed facilities are not available in any of the districts in Delhi and even with availability of adequate funds and personnel, it will take several years for such facilities to be developed adequately.

The Delhi Fire Services (DFS) is the only organisation that has modest skills and the facilities for dealing with the chemical accidents. The DFS has the self-contained breathing apparatus with trained personnel for their use as a part of their 34 fire stations in Delhi. **According to a DFS fire official, these things are still on paper as they have no proper gears to deal with when such accidents happen.**

Centralised Accident and Trauma Services (CATS) is an emergency medical service with a fleet of 20 roving ambulances and a co-ordinating control room. The CATS control room has a wireless links with major hospitals in Delhi. A total number of 23 hospitals with 427 beds, 42 ambulances and 26 other vehicles have been identified for emergency support by the State Government as a part of the last plan.

The emergency plan which looks good on the paper faces many problems like;

- Delhi's nine districts cover relatively small area, where emergencies occurring in a district could affect neighbouring districts;
- The population density across the NCT is very high posing problem like traffic management and evacuation;
- The structure and reporting lines of Police, Health and Fire Services are centralised with responsibilities divided between various State and Central Government Departments.
- There are many uncharted risks such as chemical and plastic markets and small-scale industries, many of which use hazardous materials.

When asked about the viability of this plan ADM Virendra Sharma, who is looking after the implementation of emergency preparedness plan said, " let the emergency happen, only then will we be able to give the viability of the plan".

Incident reporting

In case of any incident the normal reporting is through following means,

- Direct call to Police Control Room on telephone "100"
- Direct call to Fire Control Room on telephone "101"
- Direct call to CATS Control Room on telephone "1099"

Upon the receipt of information of an environmental incident or apprehension, the PCR shall take the following steps;

- Immediately inform the following persons/agencies of the incident,
 - FCR of the incident to arrange for the response personnel to reach the scene.
 - Inform DPCC and the appropriate technical experts to reach the scene for providing advice. The DPCC will arrange for local laboratory of their own or CPCB.
 - In case of potential for affecting any water works, inform the respective water works and the MCD of the eminent danger.
 - The Delhi Jal Board control room through the PCR (Tel. No. 1916)

LEGAL FRAMEWORK GOVERNING INDUSTRIAL AREAS:

There are various legislation pertaining to the prevention and control of pollution. Even Constitution's 42nd amendment under the Article 48 A, the provision which deals with the protection and improvement of environment reads: "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country". The Courts through various judgements (*Kinkri Devi*, *L.K. Koolwal*) have also taken a note of provisions of Article 21 and held that environmental degradation violates the fundamental right to life.

There are various laws governing the environment and labour protection and set reasonably good standards, but the implementing machinery is weak and funding of facilities poor. There is too much emphasis on government and its machinery but little or no scope for workers or the community to intervene effectively. The various related laws are;

- **Water (Prevention and Control of Pollution) Act of 1972;**
- **Air (Prevention and Control of Pollution) Act of 1981;**
- **The Environment (Protection) Act, 1986,** This Act was enacted to implement the decisions taken at the UN Conference on the Human Environment held at the Stockholm in June 1972. *This is the first comprehensive law, which covers air, water and noise pollution as also other matters relating to industrial and environmental hazards, including the handling of hazardous material. But this gives a very little right for workers or the community to take action against the polluting units. There is no provision for right to information, no right to take samples, monitor and sue the industry under EPA, unless the government and its authorities co-operate.*
- **Hazardous Processes & the Factories Act, 1948:** The Bhopal Gas Tragedy and the Oleum gas leakage from Shrirams Foods and Fertilisers, lead to the amendment in the 1987 to the Factories Act, 1948. The amendment has introduced special provisions related to the hazardous industrial processes in an effort to tackle the risks and dangers not only to the workers but also to the general public residing in the vicinity of the factory.
The right to information: The law makes it compulsory for the occupier of the factory to disclose all the information regarding dangers, health hazards and the measures to overcome such hazards, in case of hazardous processes to the workers, Chief Inspector of

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factories, the local authority and the general public.

Worker's Right: Under the Sec. III- A of the factories Act, the workers have a right to:

- Obtain from their Employer information relating to their health and safety at work;
- Get trained within the factory or get sponsored by the employer for getting such training.
- Represent to the Inspector directly or through union representatives in the matter of inadequate provision for the protection of their health or safety in the factory.

- **Manufacture, Storage and Import of Hazardous Chemicals Rules of 1989:** The main purpose of this rules is to regulate handling and storage of hazardous chemicals and to prevent and contain accidents from the industrial activities and storage involving such hazardous chemicals. Rule 14 requires the Authority specified under the under the column 2 of the schedule 5 to prepare and keep up-to-date an adequate off-site management plan detailing how emergencies relating to a possible major hazard on the site would be dealt with.

Authority(ies) with legal backing	Duties and corresponding rule
1. MoEF under the EPA –1986	Notification of the hazardous chemicals as per rule 2(e) (i), 2(e) (ii) and 2 (e) (iii)
2. Chief Controller of Imports and Exports under the Import and Export (Control Act), 1947	Import of Hazardous chemicals as per rule 18
3. CPCB and State Pollution Control Board under EPA- 1986.	Enforcement of directions and procedures in respect of isolated storage of hazardous chemicals like:- <ul style="list-style-type: none"> • Notification of major accidents as per rule 5(1) and 5(2) • Notifications of site as per rules 7 and 9 • Safety reports in respect of isolated storages as per rules 10 and 12 • Preparation of on-site emergency plans as per rule 13
Chief inspector of Factories appointed under the Factories Act, 1948	Enforcement of directions and procedures in respect of industrial installations and isolated storages covered under the Factories Act, 1948, dealing with hazardous chemicals and pipelines <ul style="list-style-type: none"> • Notification of sites as per rules 7 to 9 • Safety reports as per rules 10 and 12 • Preparation of of-site emergency plans as per rule 13 • Preparation of off-site emergency plans in consultation with District Collector or District Emergency Authority.
District Collector or District Emergency Authority designated by the State Government.	Preparation of off-site emergency plans as per rule 14

- **The Emergency Planning, Preparedness and Response to Chemical Accident Rules (EPPRCA)** notified in August provides specific focus on the management of chemical accident emergencies. The regulation requires the management of chemical accident and the key requirements/provisions are.

Formation of a Central Crisis Group and Crisis Alert system (by the Central Government) with defined functions and roles.

Formation of State Level, District Level and Local Level crisis groups by State Governments with defined roles and responsibilities in the planning.

RECOMMENDATIONS

In the past three decades, Delhi has grown from a largely administrative center to an important industrial and commercial centre in India. Industry coming into Delhi has been integral to this transformation. The downside of this change has been unfettered and environmentally unsustainable development. This is evident with the government's attempts to push industry out of the center and into the periphery of the capital. Based on the findings of this report, we propose several recommendations to guide in the planning of a city that will provide a place for industry to grow while still being protective of human health and the environment.

- **There is a need for a clear demarcation of authority and responsibility amongst the various civic authorities in Delhi:** Delhi is characterised by the multiplicity of the authorities carrying out various civic functions, some of them come under the control of Central government and some under the State government. During crisis situation it creates a lot of difficulty in fixing accountability. There is also a need for better co-ordination and information exchange among the various authorities governing the industrial areas in Delhi. The various aspects of the industrial areas are monitored by different authorities like Municipal Corporation of Delhi (MCD), New Delhi Municipal Corporation (NDMC), Delhi Vidhut Board (DVB), Delhi Jal Board (DJB) and Delhi Pollution Control Committee (DPCC). A better co-ordination among these agencies would definitely help in solving the problems associated with the industrial areas.
- **A right to information and citizen's action:** Citizen action is one of the most effective ways of ensuing long term change. In order to adequately act however, people must be able to access information in an efficient manner. The Bhopal tragedy spurred the passage of several community right-to-know laws in several countries in the mid 1980's. The idea behind the right-to-know is that if someone is being exposed to a chemical, he has the right-to-know about it. As a result, community members can now access information about contaminated sites and about pollutants being emitted into their neighbourhoods. In India, however, community struggles have had little success in winning the "right-to-know" for ourselves. People should be able to identify any contaminated sites in their area and chemical emissions to the air and water. Giving individuals the resources with which to fight will help keep industry in line and will produce a better-informed citizenry.
- **The industrial estate should be well planned and use clean technologies:** The Master Plan for Delhi -2001 stresses the need for relocation of the hazardous industries outside Delhi. It is however important that new industrial estates provide all possible infrastructure, legal requirements prior to the relocation. These industries should use clean technologies, so as to eliminate the pollution at the source itself. The industries with similar operations should be located in one cluster, for better implementation of the pollution control measures. Unless above mentioned suggestions are taken into consideration, the whole rationale of shifting the industries from Delhi is defeated. For it would only mean a cleaner Delhi at the cost of polluted rural areas.

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- **A proper identification of hazardous industries/markets:** It is imperative that a proper identification of the highly polluting industries and markets should be scientifically undertaken. For this a committee should be constituted, comprising representatives from the Industry, Labour, Urban Development, and Environment Departments of the Government. The NGO's and scientific institutions should also be represented in the committee to identify the hazardous industries/markets. While relocating, the interest of worker should be considered so as to provide them with all the associated benefits. The Master plan for Delhi -2001 also talks about the phased approach, as hazardous industries should be first moved out followed by less polluting industries. The excessively hazardous industries should be closed and should not be allowed to relocate, and the relocation should be only granted in exceptional cases where they are able to satisfy that they will change to cleaner technologies.
- **A need to revamp the fire and medical services and also other emergency agencies:** As an immediate measure it is essential in the identified hazardous areas, that a fire station be especially equipped and personnel trained in dealing with any emergency situation in view of the hazardous chemical used or stored. The nearest medical facility should also be equipped to tackle any accident, with an antidote of the particular hazardous substance.
- **A need to create awareness amongst manufactures, traders and general public about the need for relocation and de-congestion:** It is of the utmost importance that the above categories be convinced and taken into confidence about the need for relocation. It should be emphasised, what really will benefit, from the relocation would not be just environment and human health, but also their own profitability. As they would be benefit from better infrastructure and decongestion and various modern facilities provided at the new industrial estates, and should be properly developed prior to any relocation.

Similar problems such as lack of accountability on the part of government and industry that characterized the Bhopal disaster are equally apparent in the manufacturing areas of Delhi. The patterns are the same. We are on the path to reliving Bhopal. As the capital starts a new millenium, let's think not only about short-term comforts but about solutions that will prove health protection for our children and grandchildren. Let's start looking at regulation that really holds industry accountable, requires true pollution reductions from the source and that gives people the power to become knowledgeable and hold industry responsible for its actions.

REFERENCE

- ⁱ White paper on pollution in Delhi with action plan, Ministry of Environment and Forest, Govt. of India, pp. 4
- ⁱⁱ *ibid* 1 pp. 4
- ⁱⁱⁱ *ibid* 1pp. 9.
- ^{iv} *Ibid* 1 pp21
- ^v Delhi 1999-A Factsheet by National Capital Region Planning Board pp 45
- ^{vi} National Institute of Urban Affairs (NIUA) and Central Pollution Control Board (CPCB).
- ^{vii} M.C. Mehta Vs Union of India and others (1996 (4) SCC 351)
- ^{viii} National Capital Territory : Off-Site Emergency Plan, prepared by Delhi Govt in May 1998.
- ^{ix} *Ibid* 1
- ^x Delhi Statistical Hand Book.
- ^{xi} Via internet, www.terminalcz/~blackice/disguizez/news/poison.html, November 1999.
- ^{xii} This information is based on a group of studies as listed: ATSDR (1997) ATSDR's toxicological profiles on CD-ROM, CRC Press; Chan, P.K.L. & Meek, M.E. (1994) Di-n-butyl phthalate: Evaluation of risks to health from environmental exposure in Canada, *Environ. Carcino. & Ecotox. Revs.*, C12(2): 257-268; Ema, M., Itami, T. & Kawasaki, H. (1993), Teratogenic phase specificity of butyl benzyl phthalate during early pregnancy in rats, *Toxicology*, 79:11-19; Ema, M. Kurosaka, R., Amano, H. & Ogawa, Y. (1994), Embryo lethality of butyl benzyl phthalate during Early pregnancy in rats, *Reproductive Toxicology*, 8(3): 231-236; Ema, M. Kurosaka, R., Amano, H. & Ogawa, Y. (1995), Comparative developmental toxicity of n-butyl benzyl phthalate and di-n-butyl phthalate in rats, *Arch. Environ. Contam. Toxicol.*, 28: 223-228.
- ^{xiii} Dirven, H.A.A.M., van den Brock, P.H.H., Arends, A.M.M., Nordkamp, H.H., de Lepper, A.J.G.M., Henderson, P.Th. & Jongeneelen, F.J. (1993), Metabolites of the plasticizer di(2-ethylexyl)phthalate in urine samples of workers in polyvinylchloride processing industries, *Int. Arch. Occup. Environ. Health*, 64: 549-554.
- ^{xiv} *Ibid.*, November 1999.
- ^{xv} Via internet, factsheet on di-n-butyl phthalate, <http://www.odsnet.com/TRIFact/288.html>, November 1999.
- ^{xvi} Toxicological Profile for Di-n-butyl Phthalate, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and disease Registry, 1990.
- ^{xvii} Via internet, Office of health, Health Hazard Alert, U.S. Department of Energy, <http://www.tispubf/aph.html>, November 1999.
- ^{xviii} Via internet, CEPA Assessment Reports, 1993, 32 pp., <http://www.tis-sc.gc.ca/eph/ejd/catalogue/bhccpubs/aph.html>, November 1999.
- ^{xix} Via internet, <http://www.edc/niosh/ipcs/ipcs0568.html>, November 1999.
- ^{xx} *Ibid.*, November 1999.
- ^{xxi} This information is based on a group of studies as listed: Evers, E.H.G. (1989), De vorming van PCDFs, PCDDs en gerelateerde verbindingen bij de oxychlorering van etheen, MTC Publication nr. MTC89EE, publ: Vakgroep Milieu en Toxicologische Chemie, University of Amsterdam, 62 pp.; Evers, E.H.G., Ree, K.C.M. & Olie, K. (1988), Spatial variations and correlations in the distribution of PCDDs, PCDFs and related compounds in sediments from the river Rhine-Western Europe *Chemosphere* 17(12): 2271-2288; Evers, E.H.G., van Berghem, J.W. & Olie, K. (1989), exploratory data analysis of PCDD and PCDF measurements in sediments from industrialized areas, *Chemosphere* 19 (1-6): 459-466; Wenning, R.J., Harris, M.A., Paustenbach, D.J. & Bedbury, H. (1992), Chemometric comparisons of polychlorinated dibenzo-p-dioxin and dibenzofuran residues in surficial sediments from Newark Bay, New Jersey, and other industrialized waterways, *Arch. Environ. Contam. Toxicol.*, 2: 397-413.
- ^{xxii} Fayad, N.M., Sheikheldin, S.Y., Al-Malack, M.H., El-Mubarak, A.H. & Khaja, N. (1997), Migration of vinyl chloride monomer (VCM) and additives into PVC bottled drinking water, *Journal of Environ. Sci. Health*, A32(4): 1065-1083.
- ^{xxiii} Mohanty, S.K., *Universal's Environment & Pollution Law Manual*, The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989, Universal Law Publishing Company Private Ltd., 1999, pp. 107-141.
- ^{xxiv} *Ibid.*, pp. 107-141.
- ^{xxv} Singh, Richa, Center for Education and Communication, HIV/AIDS, *Workers and Labour Rights: A Study of Vulnerability of the Workers in Wazirpur Industrial Area*, Delhi, July 1999, page A-11.
- ^{xxvi} Singh, Richa, 9,1999. "HIV/AIDS, workers and Labour rights, A Study of Vulnerability of the Workers in Wazirpur Industrial Area", Delhi, CEC
- ^{xxvii} Giri, AK and Bhattacharyya, AK, Characterization of Solid Wastes Generated in Wazirpur Industrial Area of Delhi, *Journal of Ecotoxicological Environmental Monitoring*, vol. 9(1), p. 59, 1999.
- ^{xxviii} *Ibid.*, p. 51
- ^{xxix} Design of Common Effluent Treatment Plants for Industrial Estates in NCT of Delhi, Phase II Report, Vol.-I, NEERI

